Reducing the whole subject to a short conclusion—which has involved no less than four years of work, as consecutive as the continually interruptive nature of the profession to which I belong has allowed, and the labour too of carrying out upwards of two thousand extinctions in one form or another—is this, that the perpetual whiteness of the second satellite, and the darkened tints of the others during transit (not to say in explanation of the casual appearances strange and unusual reported at other times) is due to differences in their relative albedo as compared with that of *Jupiter*, and is not dependent upon the relative quantity of light reflected by one or the other, or upon any physical peculiarities of the Jovian system.

In conclusion, I must once more be allowed to record my thanks to my friend Mr. Plummer for placing his many experiences so liberally at my disposal, and in addition for his having overlooked all the albedo computations; and also to my friend, the Rev. James Holroyde, who has kindly verified by far the majority of the contrast experiments.

Ivy House, Clapham Common, London, S.W.

The Total Solar Eclipse of 1887, *August* 19.

By Dr. Ralph Copeland.

Professor Bredichin, of Moscow, finding that the central line of the total eclipse of the sun on August 19 passed almost exactly over his country seat of Pogoste, near Kineshma, most hospitably invited the Council to nominate two members of our Society to become his guests for the purpose of observing the eclipse. The Rev. S. J. Perry was chosen as one representative of the Society, and the writer takes this opportunity of thanking the Council most heartily for having selected him as the other fortunate candidate. Thanks to the efforts of distinguished Russian *savants* and the representations of the British Foreign Office, every facility for the introduction of eclipse apparatus into Russia was afforded by the Minister of Finance at St. Petersburg.

Although the weather on the important morning was so unfavourable that no records of any scientific value were secured with the apparatus sent from Dun Echt Observatory, it may not be out of place to give a short account of the preparations that were made, and of the circumstances attending the eclipse itself.

Photographic methods seeming to offer the greatest facilities for securing unequivocal records, both of the forms and spectra of the solar appendages, it was resolved to dispense altogether with eye observations. The photographic apparatus consisted of the following parts, which were all carried by a massive equatorial mounting.

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A 6-inch telescope of about six feet focal length, with a dense flint glass prism of about 12° angle in front of the object-glass formed an open spectroscope. This was for photographing the chromosphere as a series of more or less separated rings of different degrees of refrangibility. It would also have given sharp narrow spectra of any specially brilliant points in the prominences or chromosphere.

Riding on this telescope was a star spectroscope with a 2-inch object-glass to form an image on the slit. This combination was directed so as to point some minutes of arc clear of the Sun's limb, when his image was central in the other instruments, with a view to photographing the spectrum of the corona.

Secured to the long free end of the declination axis was a camera of four inches aperture and thirty-two inches focus. This camera is the one which was so successfully used for Lord Crawford, in India, by Mr. Davis in 1871, and by using it for short and very short exposures, it was hoped that it might again give good photographs of the corona and prominences.

Partly balancing the preceding instrument with regard to the declination axis was a landscape camera, fitted with a spool of Eastman negative paper, for securing such views of the corona as could be obtained with about one minute's exposure.

Clamped on the long-focus instrument was yet another camera of large aperture with a 5-inch × 4-inch plate. This was to have been exposed for nearly the whole time of totality to determine the extreme photographic extent of the corona. After some trials it was arranged that the cameras at the tail end of the declination axis should be worked by James Macpherson, the attendant from Dun Echt Observatory, whom Lord Crawford had very considerately sent with the party, while I looked after the pair on the declination side. Two of Professor Bredichin's pupils kindly undertook to note down the time for us.

To simplify the working of so many cameras one set of slides fitted both the 6-inch telescope and the 4-inch camera, while another set were common to the small camera and the star spectroscope. The mounting having been originally designed by Messrs. T. Cooke & Sons for an 8-inch telescope was not at all overloaded with this apparatus. Several features in this mounting afford such great facilities in setting up the instrument that they well deserve mention as specially desirable in stands designed for eclipse expeditions. They are :—Power of turning the whole head of the stand right round in azimuth and clamping and adjusting it in any position. The outside of the polar axis cradle is parallel to that axis, which can therefore be inclined at the proper angle under the guidance of a spirit-level and angle-gauge. The declination axis is provided with a spirit-level.

The detached bath-house at Pogoste having been placed altogether at our disposal was easily turned into so convenient a

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dark-room that the necessary trials of plates were made with every comfort. A reflecting circle belonging to Professor Bredichin provided the time with all desirable accuracy for the work contemplated.

As the object-glass prism deflected the light about 8°, the 6-inch telescope had to be directed to a point at that distance from the Sun. By turning the refracting edge of the prism round the optical axis of the telescope this deviation can be made to take effect in any direction, but the most convenient direction is either along an hour circle or to a point in the same parallel as the object under observation. The latter position was chosen as being more likely to throw the spectra of the prominences clear of each other in photographs taken near the beginning and end of totality.* It also simplified the attachments for the small spectroscope and the cameras.

For some time before our arrival at Pogoste, on August 4, the weather had been very fine, but a heavy thunder-shower on the afternoon of the next day was the beginning of a complete change in the weather. For, although it was repeatedly clear just at sunrise, it was very seldom that uninterrupted views of the sun or stars could be obtained. At 5 A.M. on the morning to which we had all been looking forward for so many months, the sky was almost altogether overcast, but about the time of first contact the clouds separated so that the Sun shone brightly. But when about half the Sun was eclipsed the drifting clouds began again to thicken so quickly that some twenty-five minutes before the total phase the Sun was completely obscured. The daylight now began to lessen rapidly; this, together with the swiftly moving cloud-drift, indicative of a strong wind overhead, closely resembled the gathering of a thunderstorm. So close was this resemblance that it required some effort to bear in mind that the darkness was mainly due to the progress of the eclipse, and that in spite of the fading light the clouds might possibly be clearing away. As will be seen, this is exactly what happened, but the favourable change unfortunately came a few minutes too late. Not knowing how dark it might become, a couple of candles were kept burning on a table some ten feet behind the instrument. When the chronometer showed that totality had already commenced, I noticed that the candles cast a distinct shadow of the observer on the instrument. At the same time the sky gave so much light as to remove all fear of being inconvenienced by the obscurity. The candles were therefore blown out. The precious moments of darkness slipped away, until just at the very last instant of totality the eclipsed Sun, surrounded by a brilliant ring of corona, burst out through a small opening in the clouds. Apparently at the very same moment the light of the Sun broke forth. Every effort was made to

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* Something might be gained in this respect by making the deflection take effect in the plane of the Moon's orbit.

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obtain photographs, and it was not until the negatives were developed that all hope of having secured some traces of the corona and prominences were given up. As might be expected, the spectroscopic negatives of the narrow solar crescent show some of the chief lines of the spectrum, H and H_1 being easily recognised. The star-spectroscope, too, yielded a very fair spectrum, but it is merely that of daylight. Many negatives of partial phase were taken, but they only serve to show that the plates were in good order.

One circumstance may be mentioned as showing how near we were to one of the few spots where the eclipse was well seen. During totality I had noticed that the sky near the S.S.E. horizon, which was visible from my post, was quite clear, and tinged as if the sun were setting. A few days afterwards we learnt from the captain of the Volga steamer *Alaska*, which was then between Kineshma and Nischni Novgorod, that he had seen the whole of the total phase unimpeded by clouds. His position would about agree with the clear gap visible from Pogoste.

I cannot conclude without expressing my warmest thanks to Professor Bredichin for the hearty welcome which he and his whole family accorded to us in Russia.

Dun Echt Observatory :
1887, *November* 9.

The Total Solar Eclipse of August 19, 1887. By the Rev. S. J. Perry, F.R.S.

Although the clouds interfered most seriously with the observation of the solar eclipse on August 19, I feel it to be my duty, as a delegate of the Council, to lay before the Society a brief report of the manner in which their mission was carried out; and I trust that some at least of the details I am about to mention may not be found useless for future eclipse observers. Most of the Fellows will remember that our associate Professor Bredichin sent a very generous invitation to the Society, offering hospitality to any two of its members who might wish to observe the total eclipse, and that Dr. Copeland and myself had the honour of being nominated by the Council as the representatives of the Society.

The Astronomer Royal most kindly placed at my disposal the coronagraph and photo-spectroscopes used by Mr. Maunder in 1886; so I resolved at once to devote my whole attention to the photographic portion of our work. A full description of the instrument will be unnecessary. It will suffice to mention that two spectroscopes, with cameras attached, were fastened to the square tube of the coronagraph, and the same tube carried a